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(54) **SOLAR CELL MODULE**

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Dec. 22, 2011 (JP) 2011-281565

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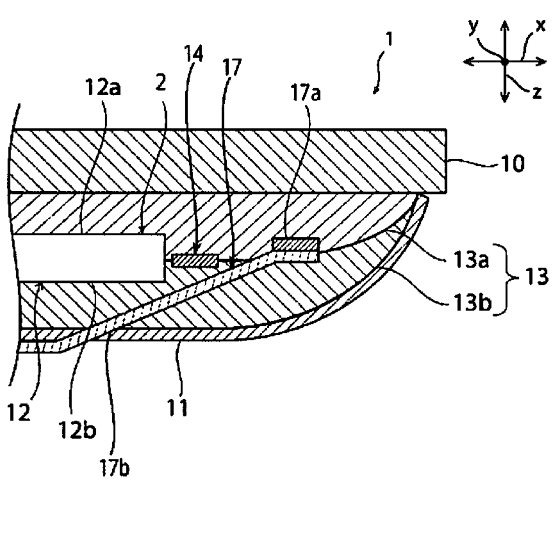
(57) **ABSTRACT**

Provided is a solar cell module wherein solar cells and a sealing material, which is sealing the solar cells, are not easily peeled from each other. A solar cell module is provided with solar cells, a wiring material, and a sealing material. Each of the solar cells has first and second main surfaces. The wiring material is electrically connected to each of the solar cells on the first main surface. The sealing material seals the solar cells. The sealing material has a first sealing section and a second sealing section. The first sealing section contains a non-bridging resin. The first sealing section is positioned on the first main surface side of the solar cells. The second sealing section contains a bridging resin and pigment. The second sealing section is positioned on the second main surface side of the solar cells.

9 Claims, 5 Drawing Sheets



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H01L 31/056	(2014.01)
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B32B 15/08	(2006.01)
B32B 15/20	(2006.01)
B32B 27/08	(2006.01)
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B32B 27/30	(2006.01)
B32B 3/02	(2006.01)
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Fig.1

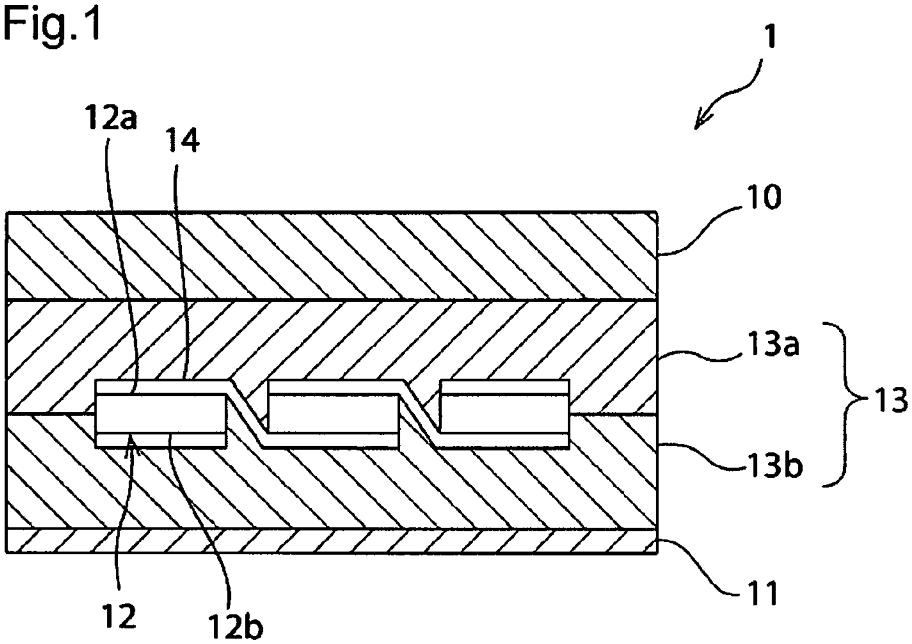

1
12a
14
10
13a
13
13b
11
12
12b

Fig.2

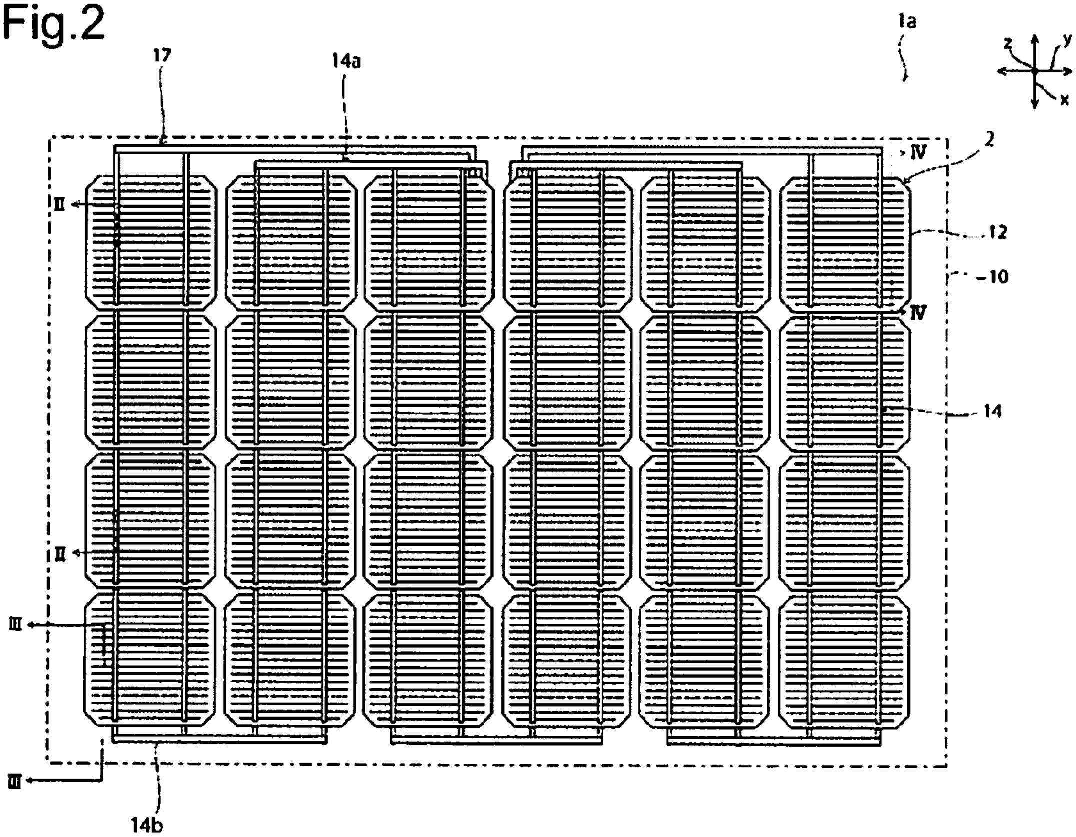
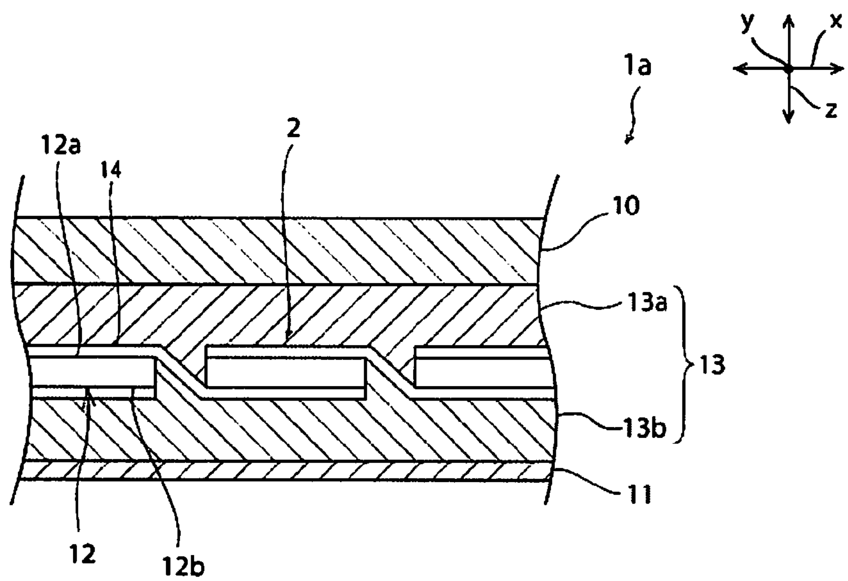

1a
z
y
x
17
14a
IV
2
12
II
10
IV
14
II
III
III
14b

Fig.3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y
x
z
2
12a
14
10
13a
13
13b
11
12
12b

Fig.4

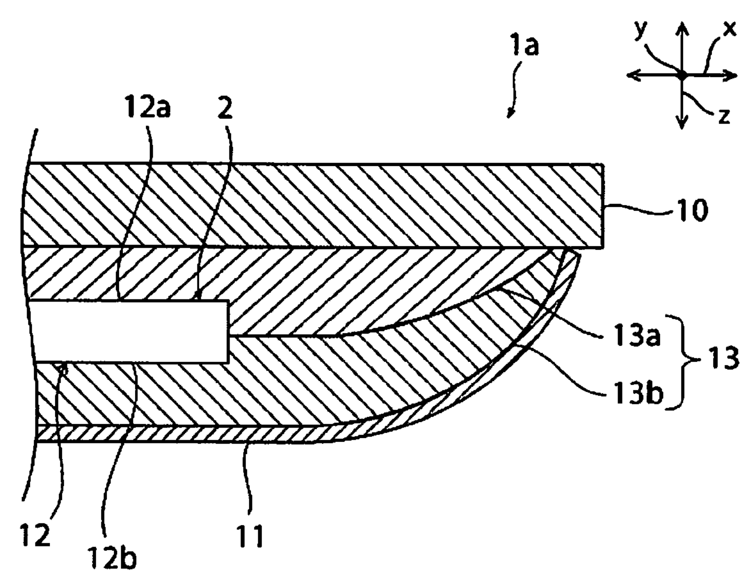
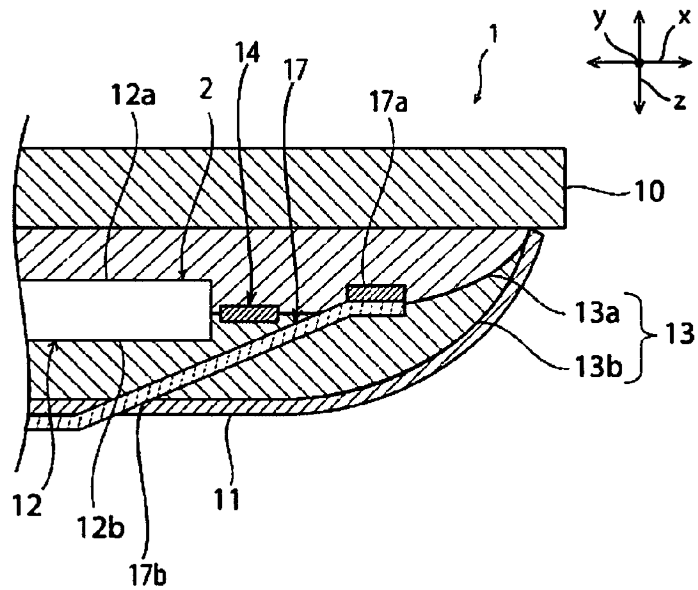
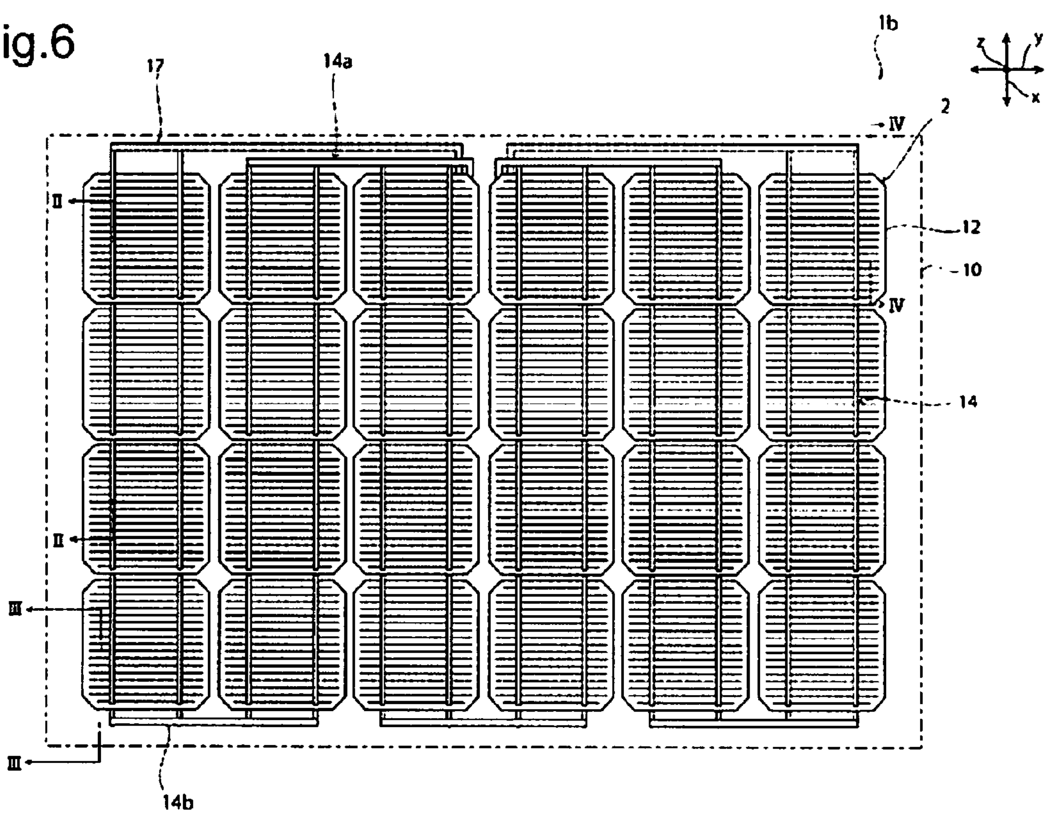

1a
y
x
z
12a
2
10
13a
13
13b
12
12b
11

Fig.5



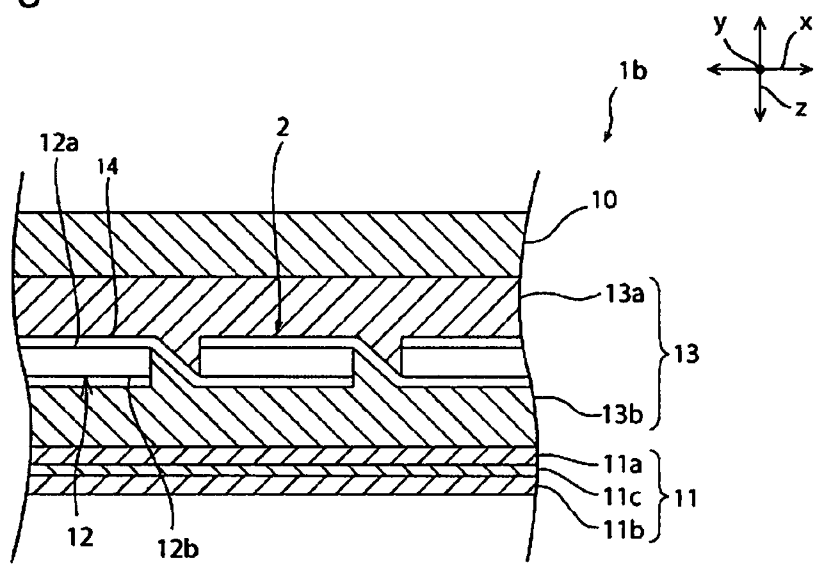
1
y
x
z
14
17
12a
2
17a
10
13a
13
13b
12
12b
11
17b

Fig.6



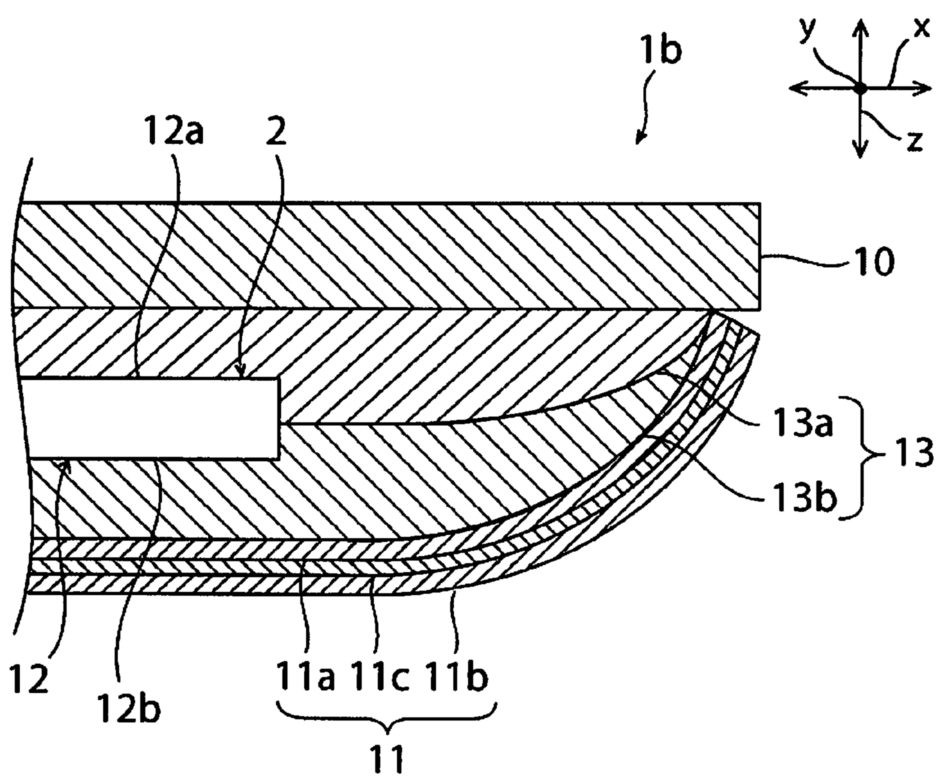
1b
z
y
x
17
14a
IV
2
II
12
10
IV
14
II
III
III
14b

Fig.7



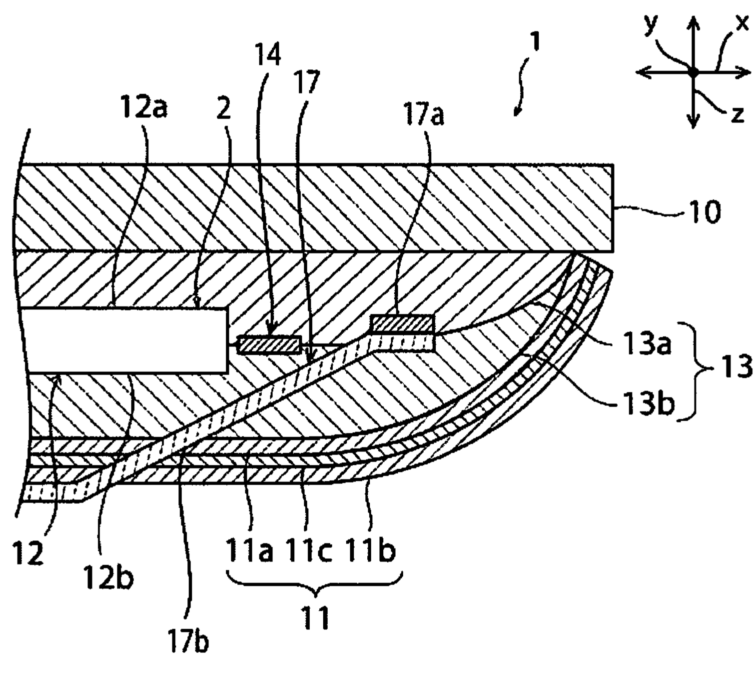
y
x
z
1b
2
12a
14
10
13a
13
13b
11a
11c
11
11b
12
12b

Fig.8



1b
y
x
z
12a
2
10
13a
13
13b
12
12b
11a 11c 11b
11

Fig.9



SOLAR CELL MODULE

CROSS REFERENCE TO RELATED APPLICATIONS

This application is a continuation application of International Application No. PCT/JP2012/078834, filed on Nov. 7, 2012, entitled "SOLAR CELL MODULE", which claims priority based on Article 8 of Patent Cooperation Treaty from prior Japanese Patent Applications No. 2011-246067, filed on Nov. 10, 2011, No. 2011-281438, filed on Dec. 22, 2011, and No. 2011-281565, filed on Dec. 22, 2011, the entire contents of which are incorporated herein by reference.

TECHNICAL FIELD

The invention relates to a solar cell module.

BACKGROUND ART

In recent years, solar cell modules have attracted attention as an environmentally-friendly energy source.

For example, Patent Document 1 discloses a solar cell module obtained by laminating a first main surface side sealing material, a solar cell element group including solar cell elements arrayed therein, a white-colored or colored second main surface side sealing material and a second main surface protection material in this order on a transparent substrate. In this solar cell module, the first main surface side sealing material is made of a transparent material. The first and second main surface side sealing materials are each made of ethylene-vinyl acetate copolymer.

PRIOR ART DOCUMENT PATENT DOCUMENT 1: Japanese Patent Application Publication No. 2005-79170

SUMMARY OF THE INVENTION

In the solar cell module as described in Patent Document 1, solar cells and the first main surface side sealing material are likely to separate from each other.

One aspect of the invention is to provide a solar cell module in which a solar cell and a sealing material are less likely to separate from each other.

A solar cell module of an embodiment includes a solar cell, a wiring material and a sealing material. The solar cell has first and second main surfaces. The wiring material is electrically connected to the solar cell on the first main surface. The sealing material seals the solar cell. The sealing material has a first sealing section and a second sealing section. The first sealing section contains a non-crosslinking resin. The first sealing section is positioned on the first main surface side of the solar cell. The second sealing section contains a crosslinking resin and pigment. The second sealing section is positioned on the second main surface side of the solar cell.

According to the solar cell module described above, a solar cell and a sealing material are less likely to separate from each other.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a schematic cross-sectional view of a solar cell module according to a first embodiment.

FIG. **2** is a schematic plan view of a solar cell module according to a second embodiment.

FIG. **3** is a schematic cross-sectional view taken along the line II-II in FIG. **2**.

FIG. **4** is a schematic cross-sectional view taken along the line in FIG. **2**.

FIG. **5** is a schematic cross-sectional view taken along the line IV-IV in FIG. **2**.

FIG. **6** is a schematic plan view of a solar cell module according to a third embodiment.

FIG. **7** is a schematic cross-sectional view taken along the line II-II in FIG. **6**.

FIG. **8** is a schematic cross-sectional view taken along the line in FIG. **6**.

FIG. **9** is a schematic cross-sectional view taken along the line IV-IV in FIG. **6**.

EMBODIMENTS

Embodiments of the invention are described below. However, the following embodiments are merely illustrative. The invention is not limited to the following embodiments.

In addition, the drawings to be referred to in the embodiments are schematic, and ratios of dimensions of objects drawn in the drawings and the like may be different from those of actual ones. Therefore, specific ratios of dimensions of the objects and the like should be determined in consideration of the following description.

(First Embodiment)

As illustrated in FIG. **1**, solar cell module **1** includes solar cells **12**. Each of solar cells **12** has first main surface **12*a*** and second main surface **12*b***. The type of solar cells **12** is not particularly limited. Solar cells **12** may be crystalline silicon solar cells, polycrystalline silicon solar cell and the like, for example. Solar cell **12** may generate power only when receiving light on first main surface **12*a***. Alternatively, solar cell **12** may generate power not only when receiving light on first main surface **12*a*** but also when receiving light on second main surface **12*b***.

Solar cell **12** includes a first electrode provided on the first main surface **12*a*** side and a second electrode provided on the second main surface **12*b*** side. One of the first and second electrodes collects electrons and the other one collects holes.

Solar cells **12** are electrically connected to each other by wiring materials **14**. More specifically, the first electrode in one of adjacent solar cells **12** is electrically connected to the second electrode in the other one by wiring material **14**. Thus, a one-side portion of wiring material **14** is electrically connected to solar cell **12** on first main surface **12*a***.

Note that wiring material **14** and solar cell **12** are bonded with resin adhesive or solder. It is preferable that wiring material **14** and solar cell **12** are bonded with resin adhesive. The resin adhesive may contain a conducting material.

Sealing material **13** seals solar cells **12**. Sealing material **13** has first sealing section **13*a*** and second sealing section **13*b***. First sealing section **13*a*** is positioned on the first main surface **12*a*** side of solar cell **12**. Second sealing section **13*b*** is positioned on the second main surface **12*b*** side of solar cell **12**.

First sealing section **13*a*** contains a non-crosslinking resin. The non-crosslinking resin is preferably a resin containing no vinyl acetate monomer unit, and is more preferably a polyolefin resin containing no vinyl acetate monomer unit. The polyolefin resin containing no vinyl acetate monomer unit preferably contains at least one of polyethylene resin and polypropylene resin.

Note that, in the embodiment, the non-crosslinking resin means a resin having a gel fraction of 50% or less. In the embodiment, the "gel fraction" is measured by the following measurement method. First, 1 g of a resin to be measured is prepared. Then, the resin is immersed in 100 ml of xylene for 24 hours at 120° C. Thereafter, residues in xylene are extracted and then dried at 80° C. for 16 hours. Subsequently, the mass of the dried residues is measured. From the result thus obtained, the gel fraction (%) is calculated based on the following equation (1).

$$(\text{gel fraction}(\%))=(\text{mass of residues}(g))/(\text{mass of resin before immersion}(g)) \quad (1)$$

Second sealing section **13***b* contains a crosslinking resin. The crosslinking resin is preferably an ethylene-vinyl acetate copolymer (EVA). In the embodiment, the crosslinking resin is a resin having a gel fraction of more than 50%.

Second sealing section **13***b* contains pigment. The color of pigment is not particularly limited, and may be white, for example. Specific examples of the white pigment include titanium dioxide, zinc oxide, white lead, barium sulfate, barium borate, calcium carbonate, magnesium oxide, and the like, for example.

Sealing material **13** is disposed between first protection member **10** and second protection member **11**. First protection member **10** is located to the first main surface **12***a* side of solar cell **12**. First protection member **10** can be made of a glass plate or the like, for example. Second protection member **11** is located to the second main surface **12***b* side of solar cell **12**. Second protection member **11** faces first protection member **10**. Second protection member **11** can be made of a resin, for example. Second protection member **11** may have a metal layer made of aluminum or the like or an inorganic layer made of silica or the like.

In a solar cell module described in Patent Document 1, first and second main surface side sealing materials are made of ethylene-vinyl acetate copolymer, and the first main surface side sealing material (the sealing material on the light receiving surface side) is made transparent and the second main surface side sealing material (the sealing material on the rear surface side) is colored in white. In such a solar cell module, solar cells and the first main surface side sealing material are likely to separate from each other.

On the other hand, in solar cell module **1**, first sealing section **13***a* positioned on the first main surface **12***a* side of solar cell **12** contains the non-crosslinking resin. This prevents solar cells **12** and first sealing section **13***a* from separating from each other. The possible reason for this is as follows. The addition of pigment to the second sealing section causes a difference in property between the first sealing section containing no pigment and the second sealing section containing pigment. Normally, the second sealing section containing pigment becomes more rigid than the first sealing section containing no pigment. Therefore, stress caused by the difference in rigidity between the first and second sealing sections makes the solar cells and first sealing section **13***a* likely to separate from each other on the first sealing section side of the solar cells. Here, in solar cell module **1**, first sealing section **13***a* contains the non-crosslinking resin. This increases the adhesion strength of first sealing section **13***a* not only at normal temperature but also at a high temperature of 75° C. or higher. This increased adhesion strength is considered to suppress separation between solar cells **12** and wiring materials **14** on the first sealing section **13***a* side.

The non-crosslinking resin contained in first sealing section **13***a* is softened at a high temperature of 75° C. or higher, thereby relieving the stress and increasing the adhesion to solar cells **12**. Thus, solar cells **12** and first sealing section **13***a* are less likely to separate from each other.

When the crosslinking resin contained in second sealing section **13***b* is the ethylene-vinyl acetate copolymer, the rigidity of the resin is high even at a high temperature of 75° C. or higher after crosslinking. However, the stress is relieved by lowering the rigidity of first sealing section **13***a*. Thus, solar cells **12** and first sealing section **13***a* are less likely to separate from each other.

The invention is described in more detail below based on specific examples. The invention is not limited to the following examples but can be carried out by making appropriate changes without departing from the scope of the invention.

(Embodiment Example)

In Embodiment Example 1, a solar cell module having substantially the same configuration as that of solar cell module **1** according to the above embodiment is prepared by using a transparent non-crosslinking resin to form first sealing section **13***a* and using a crosslinking resin containing white pigment to form second sealing section **13***b*. To be more specific, a polyolefin resin containing no vinyl acetate monomer unit is used as a material to form first sealing section **13***a*. Also, an ethylene-vinyl acetate copolymer (EVA) containing titanium dioxide is used as a material to form second sealing section **13***b*.

COMPARATIVE EXAMPLE 1

In Comparative Example 1, a solar cell module having substantially the same configuration as that of Embodiment Example 1 is prepared, except that a transparent crosslinking resin is used to form first sealing section **13***a* and a white crosslinking resin is used to form second sealing section **13***b*. To be more specific, an ethylene-vinyl acetate copolymer (EVA) containing no white pigment is used as a material to form first sealing section **13***a*. Also, an ethylene-vinyl acetate copolymer (EVA) containing titanium dioxide is used as a material to form second sealing section **13***b*.

COMPARATIVE EXAMPLE 2

In Comparative Example 2, a solar cell module having substantially the same configuration as that of Comparative Example 1 is prepared, except that a crosslinking resin containing no white pigment is used to form second sealing section **13***b*. To be more specific, an ethylene-vinyl acetate copolymer (EVA) containing no white pigment is used as a material to form first sealing section **13***a*. Also, an ethylene-vinyl acetate copolymer (EVA) containing no white pigment is used as a material to form second sealing section **13***b*.

For the respective solar cell modules of Embodiment Example 1 and Comparative Examples 1 and 2 thus prepared, moisture resistance tests are conducted. More specifically, the solar cell modules are kept in an atmosphere with a humidity of 85% and a temperature of 85° C. for a predetermined period of time of 1000 hours or more. Thereafter, it is visually observed whether or not first sealing section **13***a* is peeled off. Table 1 shows the results.

As shown in Table 1, peel-off of first sealing section **13***a* is observed after the moisture resistance test in Comparative Example 1, while no peel-off of first sealing section **13***a* is observed even after the moisture resistance test in Embodiment Example 1. In the solar cell module of Comparative Example 2 using no white pigment, the crosslinking resin is used for both of first and second sealing sections **13***a* and **13***b* as in the case of Comparative Example 1. However, no peel-off of first sealing section **13***a* is observed even after the moisture resistance test. The peel-off of first sealing section **13***a* observed in Comparative Example 1 is considered to occur due to a change in rigidity of second sealing section **13***b*, which is caused by the addition of the white pigment to the crosslinking resin. Even when the white crosslinking resin is used for second sealing section **13***b* as in Embodiment

Example 1, the use of the transparent non-crosslinking resin for first sealing section **13***a* can prevent separation between solar cells **12** and first sealing section **13***a*.

TABLE 1

	Embodiment Example 1	Comparative Example 1	Comparative Example 2
First sealing section 13a (light-receiving surface side)	non-crosslinking resin (transparent)	crosslinking resin (transparent)	crosslinking resin (transparent)
Second sealing section 13b (rear surface side)	crosslinking resin (white)	crosslinking resin (white)	crosslinking resin (transparent)
moisture resistance test	no peel-off observed	peel-off observed	no peel-off observed

(Second Embodiment)

As illustrated in FIGS. **2** to **4**, solar cell module **1***a* includes solar cell strings **2**. Solar cell strings **2** are arranged at intervals therebetween along a y-axis direction. Solar cell strings **2** are electrically connected to each other by wiring materials **14***a* and **14***b*. Lead wirings **17** drawn out to the outside of solar cell module **1***a* are electrically connected to solar cell strings **2**.

Each of solar cell strings **2** includes solar cells **12**. In each solar cell string **2**, solar cells **12** are arranged at intervals therebetween along an x-axis direction perpendicular to the y-axis direction. In each solar cell string **2**, solar cells **12** are electrically connected to each other by wiring materials **14**.

Note that, in this embodiment, description is given of an example where the solar cell module includes solar cells. However, the invention is not limited to such a configuration. The solar cell module according to the invention may include only one solar cell.

Each of solar cells **12** has light-receiving surface **12***a* and rear surface **12***b*. Here, the "light-receiving surface" primarily means a main surface that receives light. Solar cell **12** may generate power only when receiving light on light-receiving surface **12***a*. Alternatively, solar cell **12** may generate power not only when receiving light on light-receiving surface **12***a* but also when receiving light on rear surface **12***b*.

First protection member **10** is located to the light-receiving surface **12***a* side of solar cell **12**. First protection member **10** can be made of glass or the like, for example.

Second protection member **11** is located to the rear surface **12***b* side of solar cell **12**. Second protection member **11** can be made of resin, for example. In second protection member **11**, a metal layer made of aluminum or the like or an inorganic layer made of silica or the like, for example, may be formed using a resin sheet provided therein.

Sealing material section (sealing section) **13** is provided between first and second protection members **10** and **11**. This sealing material section **13** seals solar cell strings **2**. Therefore, sealing material section **13** forms the sealing section.

Sealing material section **13** includes first sealing material section **13***a* serving as a first sealing section and second sealing material section **13***b* serving as a second sealing section. First sealing material section **13***a* is disposed between solar cells **12** and first protection member **10**. Meanwhile, second sealing material section **13***b* is disposed between solar cells **12** and second protection member **11**.

Second sealing material section **13***b* contains pigment. This pigment is to improve optical reflectivity of second sealing material section **13***b*. Pigment can be made of a white pigment such as titanium oxide, for example. Note, however, that pigment may have a color other than white as long as pigment can improve the optical reflectivity of second sealing material section **13***b*. In other words, pigment is not particularly limited as long as pigment reflects light in at least a part of a wavelength range that contributes to power generation by solar cells **12**. Meanwhile, first sealing material section **13***a* located to the light-receiving surface **12***a* side of solar cell **12** preferably contains no pigment. This is to increase the light receiving efficiency of solar cells **12**.

Each of first and second sealing material sections **13***a* and **13***b* may contain resin, for example. More specifically, each of first and second sealing material sections **13***a* and **13***b* may contain a non-crosslinking resin made of polyethylene, polypropylene or the like, or a crosslinking resin made of an ethylene-vinyl acetate copolymer (EVA), polyethylene, polypropylene or the like, for example. Second sealing material section **13***b* preferably contains the crosslinking resin, and more preferably contains the ethylene-vinyl acetate copolymer. First sealing material section **13***a* preferably contains at least one of polyethylene and polypropylene or the ethylene-vinyl acetate copolymer.

Note that, in the embodiment, the "crosslinking resin" means a resin having a gel fraction of 50% or more. On the other hand, the "non-crosslinking resin" means a resin having a gel fraction of less than 50%.

In the embodiment, the "gel fraction" is measured by the following measurement method. First, 1 g of a resin to be measured is prepared. Then, the resin is immersed in 100 ml of xylene for 24 hours at 120° C. Thereafter, residues in xylene are extracted and then dried at 80° C. for 16 hours. Subsequently, the mass of the dried residues is measured. From the result thus obtained, the gel fraction (%) is calculated based on the following equation (1).

$$(\text{gel fraction}(\%))=(\text{mass of residues}(g))/(\text{mass of resin before immersion}(g)) \quad (1)$$

As illustrated in FIG. **4**, second sealing material section **13***b* containing pigment has a gel fraction larger than that of first sealing material section **13***a* which contains no pigment and is positioned on the light-receiving surface **12***a* side of solar cell **12**. Second sealing material section **13***b* is provided so as to cover a surface and a side surface of first sealing material section **13***a*. An end of second sealing material section **13***b* comes into contact with first protection member **10**. Therefore, second sealing material section **13***b* containing pigment is provided on the entire rear surface **12***b* side and lateral side of solar cell **12**.

Next, description is given of an example of a method of manufacturing solar cell module **1***a*.

First, at least one resin sheet to form first sealing material section **13***a* is located to first protection member **10**. Then, solar cell strings **2**, at least one resin sheet to form second sealing material section **13***b*, and second protection member **11** are disposed thereon in this order. Here, the resin sheet used to form second sealing material section **13***b* is larger than that used to form first sealing material section **13***a*. The resin sheet to form second sealing material section **13***b* is disposed such that an end of the resin sheet to form second sealing material section **13***b* is exposed from the resin sheet to form first sealing material section **13***a*.

Solar cell module **1***a* can be completed by laminating the laminated bodies thus obtained.

As described above, in solar cell module **1***a*, second sealing material section **13***b* located to the rear surface **12***b* side of solar cell **12** contains pigment. For this reason, light made incident on a region of solar cell module **1***a* where no solar cells **12** are provided is diffuse-reflected by second sealing material section **13***b*. As a result, use efficiency of the light made incident on solar cell module **1***a* is increased. Therefore, improved output characteristics can be obtained.

Also, in solar cell module **1***a*, second sealing material section **13***b* containing pigment is provided so as to cover the surface and the side surface of first sealing material section **13***a*. Thus, light leakage from the side surface of solar cell module **1***a* can be suppressed. As a result, the use efficiency of the light made incident on solar cell module **1***a* can be further increased. Therefore, further improved output characteristics can be obtained.

In terms of obtaining the further improved output characteristics, the end of second sealing material section **13***b* preferably comes into contact with first protection member **10**. Also, second protection member **11** preferably covers the surface and the side surface of second sealing material section **13***b*.

Second sealing material section **13***b* preferably contains the crosslinking resin such as an ethylene-vinyl acetate copolymer. The crosslinking resin has a low fluidity even under high temperature. Therefore, by allowing second sealing material section **13***b* to contain the crosslinking resin, a low fluidity of second sealing material section **13***b* is realized even when solar cell module **1***a* reaches a high temperature. Thus, displacement of solar cells **12** and the like can be suppressed.

In terms of more effectively suppressing the displacement of solar cells **12** and the like when solar cell module **1***a* reaches a high temperature, the end of second sealing material section **13***b* containing the crosslinking resin preferably comes into contact with first protection member **10**. This configuration is particularly effective when first sealing material section **13***a* contains the non-crosslinking resin such as polyethylene or polypropylene.

Note that the non-crosslinking resin such as polyethylene or polypropylene has better adhesion properties than the crosslinking resin such as the ethylene-vinyl acetate copolymer under normal temperature. Therefore, in terms of suppressing the displacement of solar cells **12** under both normal temperature and high temperature, it is preferable that first sealing material section **13***a* contains the non-crosslinking resin and second sealing material section **13***b* contains the crosslinking resin.

Next, mainly with reference to FIG. **5**, detailed description is given of a configuration of lead wiring **17** in solar cell module **1***a* according to this embodiment. Outer end portion **17***a* of lead wiring **17** is positioned on the outer side than solar cell **12**. Lead wiring **17** is extended toward the center of solar cell module **1***a* from outer end portion **17***a*. Lead wiring **17** penetrates second protection member **11** through the inside of sealing material section **13** and reaches the surface of second protection member **11**, which is on the opposite side to sealing material section **13**.

At least a part of a portion of lead wiring **17** positioned inside sealing material section **13** overlaps with solar cell **12** in a thickness direction. Overlapping portion **17***b* of lead wiring **17**, which is a part of the portion of lead wiring **17** positioned inside sealing material section **13**, overlaps with solar cell **12** in the thickness direction. Second sealing material section **13***b* which is made of a crosslinking resin and has a low fluidity under high temperature is positioned both between overlapping portion **17***b* of lead wiring **17** and solar cell **12** and between overlapping portion **17***b* and second protection member **11**. In other words, overlapping portion **17***b* is held by second sealing material section **13***b* having a low fluidity under high temperature. Thus, displacement of lead wiring **17** when solar cell module **1***a* reaches a high temperature can be suppressed.

As described above, in manufacturing of solar cell module **1***a* having second sealing material section **13***b* positioned on both sides of overlapping portion **17***b*, another resin sheet may be provided between overlapping portion **17***b* and solar cell **12**.

(Third Embodiment)

As illustrated in FIGS. **6** to **8**, solar cell module **1***b* includes solar cell strings **2**. Solar cell strings **2** are arranged at intervals therebetween along a y-axis direction. Solar cell strings **2** are electrically connected to each other by wiring materials **14***a* and **14***b*. Lead wirings **17** drawn out to the outside of solar cell module **1***b* are electrically connected to solar cell strings **2**.

Each of solar cell strings **2** includes solar cells **12**. In each solar cell string **2**, solar cells **12** are arranged at intervals therebetween along an x-axis direction perpendicular to the y-axis direction. In each solar cell string **2**, solar cells **12** are electrically connected to each other by wiring materials **14**.

Note that, in this embodiment, description is given of an example where the solar cell module includes solar cells. However, the invention is not limited to such a configuration. The solar cell module according to the invention may include only one solar cell.

First protection member **10** is located to one main surface **12***a* side of solar cell **12**. First protection member **10** is made of glass. In this embodiment, first protection member **10** is made of glass containing alkali metal components such as sodium.

Second protection member **11** is located to the other main surface **12***b* side of solar cell **12**. At least a surface layer of second protection member **11** on the first protection member **10** side contains at least one of polyethylene and polypropylene. In this embodiment, second protection member **11** includes first portion **11***a* forming the surface layer on the first protection member **10** side, second portion **11***b* forming a surface layer on the opposite side to first protection member **10**, and third portion **11***c* provided between first and second portions **11***a* and **11***b*. First and third portions **11***a* and **11***c* contain at least one of polyethylene and polypropylene. Second portion **11***b* includes an inorganic layer made of aluminum foil, silica or the like, for example, and the like.

In solar cell module **1***b*, one main surface **12***a* of solar cell **12** serves as a light-receiving surface and the other main surface **12***b* serves as a rear surface. Here, the "light-receiving surface" primarily means a main surface that receives light. Solar cell may generate power only when receiving light on the light-receiving surface. Alternatively, solar cell **12** may generate power not only when receiving light on the light-receiving surface but also when receiving light on the rear surface.

Sealing material section **13** is provided between first and second protection members **10** and **11**. This sealing material section **13** seals solar cell strings **2**. Therefore, sealing material section **13** forms a sealing section.

Sealing material section **13** includes first sealing material section **13***a* serving as a first sealing section and second sealing material section **13***b* serving as a second sealing section. First sealing material section **13***a* is disposed between solar cells **12** and first protection member **10**. First sealing material section **13***a* contains at least one of polyethylene and polypropylene. First sealing material section **13***a* and the surface layer of second protection member **11** on the first protection member **10** side may be made of the same material or different materials.

Second sealing material section **13***b* is disposed between solar cells **12** and second protection member **11**. Second sealing material section **13***b* contains a crosslinking resin made of an ethylene-vinyl acetate copolymer (EVA), polyethylene, polypropylene or the like.

Note that second sealing material section **13***b* positioned on the rear surface side may contain pigment such as titanium oxide, for example.

As illustrated in FIG. **8**, first sealing material section **13***a* positioned on the first protection member **10** side is larger than second sealing material section **13***b* positioned on the second protection member **11** side. An end of first sealing material section **13***a* reaches outside of an end of second sealing material section **13***b*. The end of first sealing material section **13***a* comes into contact with an end of second protection member **11**.

Next, description is given of an example of a method of manufacturing solar cell module **1***b*.

First, at least one resin sheet to form first sealing material section **13***a* is located to first protection member **10**. Then, solar cell strings **2**, at least one resin sheet to form second sealing material section **13***b*, and second protection member **11** are disposed thereon in this order. Here, the resin sheet used to form first sealing material section **13***a* is larger than that used to form second sealing material section **13***b*. The resin sheet to form second sealing material section **13***b* is disposed such that an end of the resin sheet to form first sealing material section **13***a* is exposed from the resin sheet to form second sealing material section **13***b*. Then, second protection member **11** larger than second sealing material section **13***b* is disposed.

Solar cell module **1***b* can be completed by laminating the laminated bodies thus obtained.

As described above, in solar cell module **1***b*, first sealing material section **13***a* positioned between solar cells **12** and first protection member **10** made of glass contains at least one of polyethylene and polypropylene. Here, polyethylene and polypropylene have low moisture content. Thus, by allowing first sealing material section **13***a* to contain at least one of polyethylene and polypropylene, the moisture content of first sealing material section **13***a* can be lowered. Accordingly, alkali components such as Na contained in first protection member **10** are less likely to be eluted into sealing material section **13**. Therefore, the alkali components such as Na contained in first protection member **10** can be effectively prevented from reaching solar cells **12**. Thus, deterioration of solar cells **12** due to the alkali components can be suppressed. As a result, improved durability can be realized.

Moreover, in solar cell module **1***b*, at least the surface layer of second protection member **11** on the first protection member **10** side contains at least one of polyethylene and polypropylene having low moisture content. As a result, moisture is effectively prevented from permeating second protection member **11** and entering into sealing material section **13**. Furthermore, second protection member **11** comes into contact with first sealing material section **13***a* containing at least one of polyethylene and polypropylene. Thus, moisture intrusion from the side surface of sealing material section **13** is also effectively suppressed. Accordingly, deterioration of solar cells **12** and wiring materials **14** and **14***a* due to moisture is suppressed.

Both of at least the surface layer of second protection member **11** on the first protection member **10** side and first sealing material section **13***a* contain at least one of polyethylene and polypropylene. Thus, a difference in dissolution parameter of the resin contained in at least the surface layer of second protection member **11** on the first protection member **10** side and first sealing material section **13***a* can be set to 1 or less. As a result, the adhesion between the end of second protection member **11** and the end of first sealing material section **13***a* is increased. Also, separation between second protection member **11** and first sealing material section **13***a* is effectively suppressed.

In terms of realizing further improved durability, it is conceivable to allow the entire sealing material section to contain at least one of polyethylene and polypropylene. When the entire sealing material section is made of a non-crosslinking resin such as polyethylene or polypropylene, fluidity of the entire sealing material section is increased when solar cell module reaches a high temperature. As a result, there is a possibility that solar cells **12** cannot be securely fixed.

In solar cell module **1***b*, on the other hand, second sealing material section **13***b* disposed between second protection member **11** and solar cells **12** contains the crosslinking resin. Thus, the fluidity of second sealing material section **13***b* is not increased much even when solar cell module **1***b* reaches a high temperature. Therefore, displacement of solar cells **12** when solar cell module **1***b* reaches a high temperature can be suppressed.

Note that, in the embodiment, the "crosslinking resin" means a resin having a gel fraction of 50% or more. On the other hand, the "non-crosslinking resin" means a resin having a gel fraction of less than 50%.

In the embodiment, the "gel fraction" is measured by the following measurement method. First, 1 g of a resin to be measured is prepared. Then, the resin is immersed in 100 ml of xylene for 24 hours at 120° C. Thereafter, residues in xylene are extracted and then dried at 80° C. for 16 hours. Subsequently, the mass of the dried residues is measured. From the result thus obtained, the gel fraction (%) is calculated based on the following equation (1).

$$(\text{gel fraction}(\%))=(\text{mass of residues}(g))/(\text{mass of resin before immersion}(g)) \tag{1}$$

Next, mainly with reference to FIG. **9**, detailed description is given of a configuration of lead wiring **17** in solar cell module **1***b*. Outer end portion **17***a* of lead wiring **17** is positioned on the outer side than solar cell **12**. Lead wiring **17** is extended toward the center of solar cell module **1***b* from outer end portion **17***a*. Lead wiring **17** penetrates second protection member **11** through the inside of sealing material section **13** and reaches the surface of second protection member **11**, which is on the opposite side to sealing material section **13**.

At least a part of a portion of lead wiring **17** positioned inside sealing material section **13** overlaps with solar cell **12** in a thickness direction. Overlapping portion **17***b* of lead wiring **17**, which is a part of the portion of lead wiring **17** positioned inside sealing material section **13**, overlaps with solar cell **12** in the thickness direction. Second sealing material section **13***b* which is made of a crosslinking resin and has a low fluidity under high temperature is positioned both between overlapping portion **17***b* of lead wiring **17** and solar cell **12** and between overlapping portion **17***b* and second protection member **11**. In other words, overlapping portion

17*b* is held by second sealing material section **13***b* having a low fluidity under high temperature. Thus, displacement of lead wiring **17** when solar cell module **1***b* reaches a high temperature can be suppressed.

As described above, in manufacturing of solar cell module **1***b* having second sealing material section **13***b* positioned on both sides of overlapping portion **17***b*, another resin sheet may be provided between overlapping portion **17***b* and solar cell **12**.

The invention claimed is:

1. A solar cell module comprising:

a solar cell with first and second main surfaces;

a wiring material electrically connected to the solar cell on the first main surface;

a first protection member that protects the first main surface side of the solar cell;

a second protection member that protects the second main surface side of the solar cell;

a sealing material sealing the solar cell between the first and second protection members;

a lead wiring drawn from inside of the sealing member to outside of the solar cell module, the lead wiring penetrating through the second protection member,

wherein the sealing material includes a first sealing section containing a non-crosslinking resin and positioned on the first main surface side of the solar cell, and a second sealing section containing a crosslinking resin and pigment and positioned on the second main surface side of the solar cell,

the first sealing section is disposed between the solar cell and the first protection member,

the second sealing section is disposed between the solar cell and the second protection member,

the lead wiring includes an overlapping portion which is overlapped with the solar cell, between the solar cell and the second protection member, as viewed in a thickness direction of the solar cell,

the second sealing section is provided on both sides of the overlapping portion of the leading wiring in the thickness direction of the solar cell,

an end of the first sealing section reaches outside of an end of the second sealing section, and

the end of the first sealing section is in contact with an end of the second protection member.

2. The solar cell module according to claim **1**, wherein

the non-crosslinking resin contains no vinyl acetate monomer unit.

3. The solar cell module according to claim **1**, wherein

the crosslinking resin is an ethylene-vinyl acetate copolymer.

4. The solar cell module according to claim **1**, further comprising:

wherein pigment improves optical reflectivity of the second sealing section, and

the second sealing section is provided so as to cover a surface and a side surface of the first sealing section.

5. The solar cell module according to claim **4**, wherein

an end of the second sealing section is in contact with the first protection member.

6. The solar cell module according to claim **1**,

wherein the first sealing section contains at least one of polyethylene and polypropylene.

7. The solar cell module according to claim **6**, wherein

a surface layer on a first protection member side of the second protection member contains a resin whose difference in dissolution parameter from at least one of polyethylene and polypropylene contained in the first sealing section is not more than 1.

8. The solar cell module according to claim **6**, wherein

a surface layer on a first protection member side of the second protection member contains at least one of polyethylene and polypropylene.

9. The solar cell module according to claim **1**, wherein the overlapping portion of the lead wiring is sandwiched in the second sealing section with respect to the thickness direction of the solar cell module.

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